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1516 Ninth Street, 1st Floor
Sacramento, CA 95814

Submitted By:
Architectural Energy Corporation
2540 Frontier Avenue, Suite 201
Boulder, Colorado 80301

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Contact Information:

Project Manager:
Michael Siminovitch
Lawrence Berkeley National Laboratory
1 Cyclotron Road, MS 46-125B
Berkeley, California 94720
510-486-5863
MJSiminovitch@lbl.gov

AEC Program Director:
Judie Porter
Architectural Energy Corporation
2540 Frontier Avenue
Boulder, CO 80301
303-444-4149 – Voice
jporter@archenergy.com

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Final Berkeley Lamp II Development Report

Introduction

The goal of this task was “*to research and develop a prototype next generation Berkeley Lamp that integrates an occupancy sensor into a floor-based model.*” Identifying with the industrial partners several promising prototype concepts, constructing prototype luminaires based on these concepts, and evaluating the performance of these prototypes in the laboratory and in the field successfully attained this goal. The system and support materials have been forwarded to the industrial partner, Light Corporation, developers of the first version Berkeley lamp system.

Background

LBNL researchers developed the original Berkeley Lamp, primarily, for home office and hospitality applications. After initial deployment, it soon became evident that the Berkeley Lamp was generating significant user interest and excitement in the office lighting market. Subsequent and larger deployment efforts were geared more directly toward the office lighting market in order to characterize the energy savings potential and user response in offices. To date, several thousand Berkeley Lamps have been have been deployed with the vast majority in commercial office environments.

Energy Studies

These field deployment studies indicated that the Berkeley Lamp does, in fact, offer the potential to provide lighting energy savings in offices while simultaneously achieving widespread approval from users. Metering of more than 100 test sites over a period of many months indicated that energy savings of 40 to 60 percent could be expected when Berkeley Lamps were used (See Figure 1).

The test sites included private offices as well as small- to medium-sized open office areas. These savings were due jointly to the reduction of the overall lighting load in the offices (by turning off the overhead lighting) and by reducing the average hours per day of the lighting systems use. Secondary savings were also generated by the increased controllability of the lamps, allowing the users to dim the luminaires during operation.

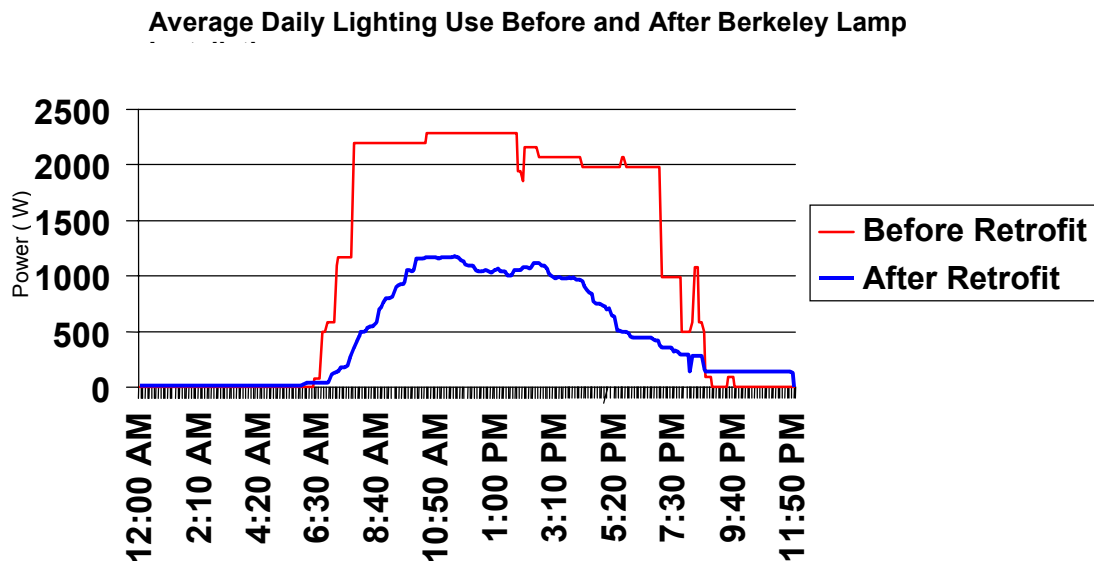


Figure 1: This large office space showed a 60 percent drop from its baseline (overhead lighting) to its retrofit (Berkeley Lamp) lighting energy usage. The area under the curve represents the energy used.

User Surveys

Web-based surveys were distributed to many of the Berkeley Lamp users in the field tests and more than 100 responses were received. The primary focus of these surveys was to determine the user satisfaction with the new Berkeley Lamp-based office lighting systems. The results of these surveys were overwhelmingly positive with more than 90 percent of users claiming the Berkeley Lamps had increased the lighting quality in their spaces (See Figure 2 and 3).

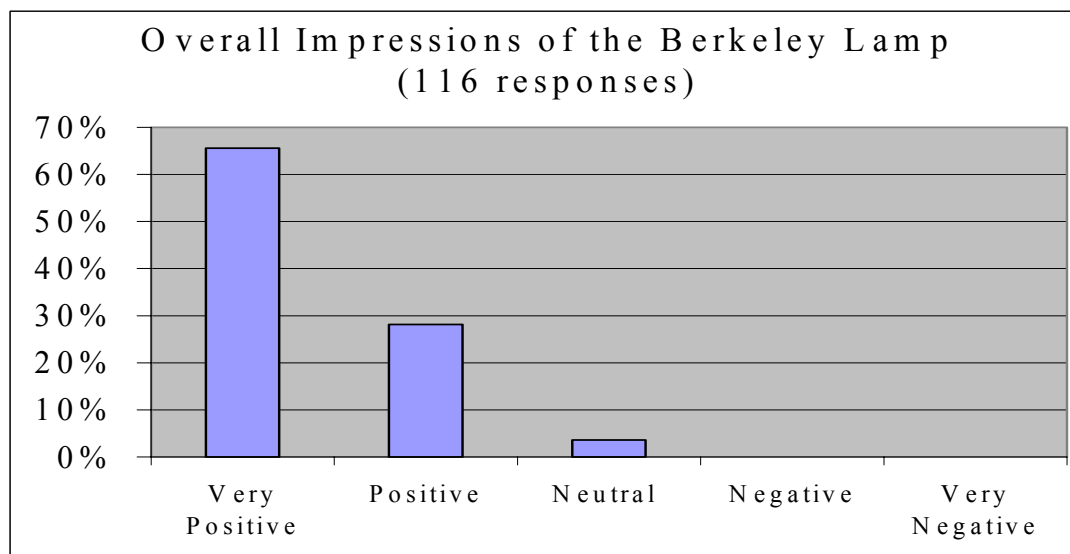


Figure 2: Surveys indicated that users have a very strong overall impression of the Berkeley Lamp.

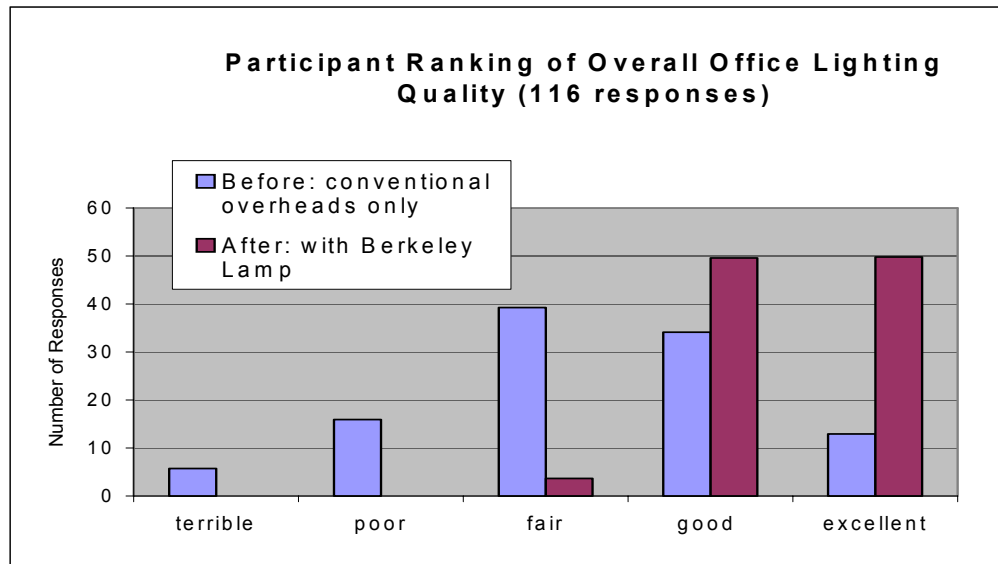


Figure 3: Surveys indicated that users felt it greatly improved their office lighting quality.

Several critiques of the Berkeley Lamp were collected both in the “comments” section of the web-based surveys and in one-on-one communications. These comments covered a wide range of issues including aesthetic, photometric, and mechanical integration concerns. By far the most common request was for a “floor lamp” version of the Berkeley Lamp. This was primarily a response to the large Berkeley Lamp footprint making it difficult at times to place the lamp on a small desk. This would often result in the lamp being forced into whatever space it might squeeze into rather than being placed at the most photometrically optimal location. Users felt that a floor lamp version would provide added flexibility of location while freeing up valuable desk space.

Development of Floor Lamp Prototypes

In response to the user requests, LBNL designed and constructed several floor lamp versions of the Berkeley Lamp. These prototypes used identical optical elements (lamps, ballast, shade and septum) to the Berkeley Lamp, but instead of the top of the shade sitting 31” above the surface (i.e. the desk) it was positioned at 72” above the floor. This height was selected to match the height of standard torchiere lamps, which are designed to be tall enough to obscure their light source from most people in order to reduce direct lamp glare.

Additionally, the floor-based Berkeley Lamps were designed with integrated occupancy sensors that would automatically turn the lamps off and on in response to occupancy. Many of the Berkeley Lamps that were field-tested were installed with occupancy power strips (i.e. they were plugged into power strips that turned on or off in response to occupancy), which proved to be a very synergistic technology for the lamp. These strips further enhanced the energy efficiency of the lamp while giving the users an added level of automatic control.

Photometrically, the output of the floor lamp version of the Berkeley Lamp is essentially identical to that of the standard Berkeley Lamp (See Figure 4). This is because, as stated previously, the optical elements are identical to their predecessor. This is not to say that the

photometric effects of the lamps are the same in real world applications, because the geometric relationships between the luminaires and the work plane are very different. One of the differences in the photometric effects is that the floor lamp version produces a wider, more uniform though less intense task plane illuminance pattern on the desk. This effect is due to the optical elements of the floor lamp being approximately 12” higher off the desk than those of the Berkeley table lamp.

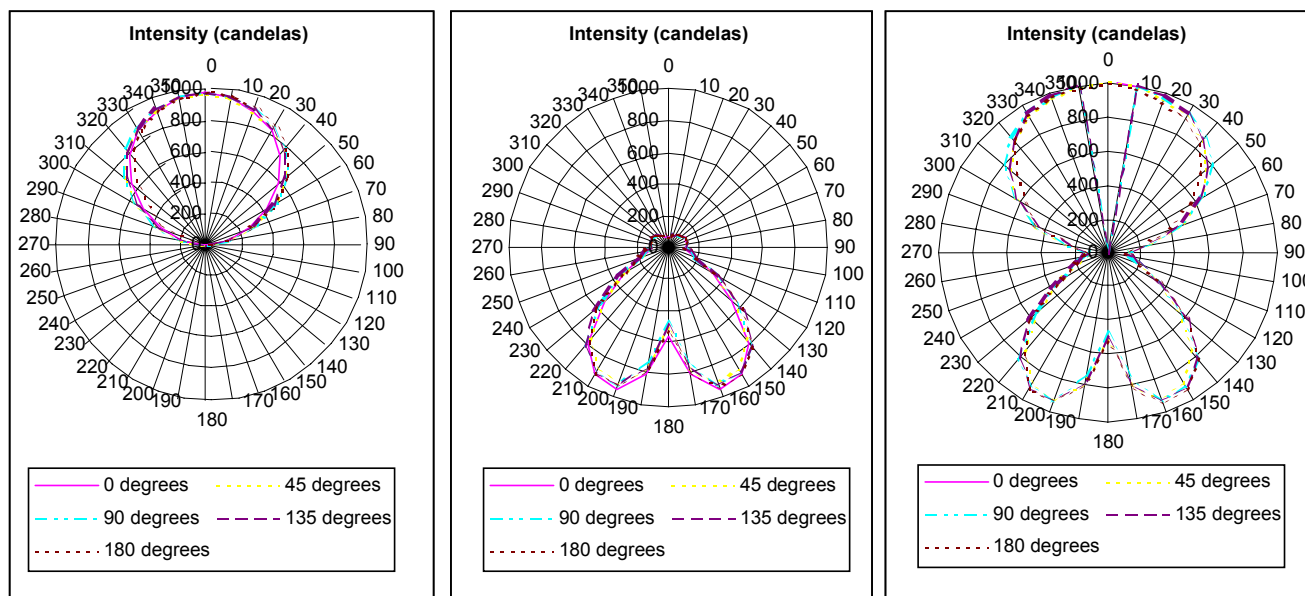


Figure 4: The candlepower plots of the floor lamp version of the Berkeley Lamp (shown in upright mode on the left, downlight mode in the middle, and up and downlight mode on the right) are identical to those of the table lamp version of the Berkeley Lamp.

Field Deployment

Two Berkeley Lamp floor-lamp prototypes were cycled through a series of office spaces to assess their performance and potential user acceptance. These prototypes were placed both in offices where occupants had prior experience with Berkeley Lamps and in offices where occupants had no prior experience with table Berkeley Lamps (see Figure 5).

These deployments were not intended to serve as a formal field study, but rather to serve as an initial indicator of the potential of this approach. Feedback from these deployments was very positive. Users largely appreciated the lighting quality of these prototypes as well as the added flexibility that the floor lamp provided. Additionally, the integrated occupancy sensor was very well received and appeared to operate as intended, providing additional energy savings. Results are also being fed into the “super torchiere” effort that also incorporates occupancy sensor technologies for portable office lighting.



Figure 5: As shown in the above images, prototype Floor Lamp Berkeley Lamps with integrated occupancy sensors were deployed in a number of offices.

Manufacturing/Commercialization Update

Throughout this development process, LBNL has continued close contact with Light Corporation, the license holder for the Berkeley Lamp technology. Light Corporation's continued goal is to develop a "family of fixtures" based on the Berkeley Lamp and they are very appreciative of the continued work in this area.

Light Corporation's immediate concerns remain focused on addressing the unacceptably high number of ballast failures that have been associated with the initial Berkeley Lamp deployments. These ballast failures have been traced to faulty products provided by one of Light Corporation's suppliers. Light Corporation has been working with this supplier and others to verify the quality of future ballast products. Light Corporation made it very clear that this ballast issue must be satisfactorily addressed before any new products will be brought to market. Recently, Light Corporation selected a new ballast product for use in the Berkeley Lamp. Based on the success of this new ballast, tooling and production efforts for the Berkeley Lamp family look to be re-started in the future.

Light Corporation has also hired a new consulting team that has extensive expertise in the marketing of energy-efficient lighting technologies to help them establish an appropriate market target as they develop Berkeley Lamp II. LBNL attended a two-day meeting with representatives of Light Corporation and the new consulting team for discussion on the future of Berkeley Lamp II. During the meeting, LBNL presented significant amounts of information based on the experiences with the Berkeley Lamp I (some of which are summarized earlier in this report), as well as some of the design ideas for Berkeley Lamp II. The outcome of this meeting was the development of several design options for new products based on the Berkeley

Lamp that would have a wider appeal in the office marketplace. These new systems would be cheaper and more flexible than the current Berkeley Lamp design. Light Corporation intends to further pursue these options.

LBNL is also working with two California state agencies (California Energy Commission and the Department of General Services) and Light Corporation on a second demonstration effort that would involve a modified redesigned Berkeley Lamp in both table and floor versions. LBNL has had a series of planning and development meetings with Light Corporation and the two state agencies to pursue this effort.